Guidewire entrapment during Greenfield filter deployment

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Prevention of pulmonary embolism by inferior vena cava filter has long been established . The Greenfield filter continues to be modified to improve deployment methods. A new filter design allows insertion through tortuous anatomy. We present, by way of a case report, a unique complication related to this design. The filter design, deployment technique, and the rationale behind them are discussed. Suggestions for avoiding this problem are provided. (J Vasc Surg 1998;27:174-6.)

Greenfield filter placement in the inferior vena cava is a safe and effective means of preventing pulmonary embolism caused by lower extremity deep venous thrombosis.[1] A recently introduced technique involves over-the-guidewire insertion.[2] There are no reported complications directly related to this new technique. However, we present the case of a patient in whom the guidewire entangled during deployment, requiring surgical extraction.

CASE REPORT

A 73-year-old man with known metastatic carcinoma of the rectum and prostate was admitted with rectal bleeding. Four weeks before admission the patient underwent a transrectal excision of a carcinoma. During this hospitalization, unilateral leg swelling developed and deep venous thrombosis was diagnosed by duplex scanning. Anticoagulation therapy was contraindicated because of the rectal bleeding and the brain metastases; therefore, a vena cava filter was inserted.

A Greenfield stainless steel filter (Medi-Tech/Boston Scientific Corporation, Watertown, Mass.) was inserted via the right internal jugular vein approach. An over-the-guidewire technique was used with fluoroscopic guidance. This method involves advancing the carrier system to the infrarenal vena cava with the guidewire in place during deployment. In this case, the guidewire was visualized exiting distal to the filter with a gentle curve. The guidewire was held stationary during any advancements. There did not appear to be any kinks or buckles in the wire before deployment. After the filter was deployed, attempts at removal of the guidewire were unsuccessful. The guidewire became entrapped between the legs of the filter (Fig. 1).

An attempt to straighten the guidewire only worsened the entanglement. This was done by advancing the guidewire; however, the wire moved past the filter in a loop rather than through the filter. When this loop was pulled back it passed instead between the legs of the filter. This explains the configuration of the wire seen in Fig. 1. A percutaneous attempt at extraction via a femoral approach was unsuccessful. Despite engaging the filter from an inferior direction with a snare, we were unable to dislodge it. No consideration was given to simply cutting the wire and leaving it and the filter in place, because it would have been a source for additional thrombosis. Laparotomy and extraction of the filter with placement of an Adams-DeWeese vena cava clip was performed (Fig. 2).

We exposed the vena cava directly over the filter and obtained proximal and distal control by direct compression. The vena cava was opened longitudinally over the filter. The guidewire was cut and the filter very carefully removed without any inadvertent injury to the vessel. The vena cava was closed primarily in a running fashion with nonabsorbable suture.

DISCUSSION

As the number of indications for vena caval interruption has increased, so has the number of different devices being used. The Greenfield filter has been used extensively with excellent results.[1] Numerous modifications to design and material have greatly improved the method of deployment. The newest innovation is an "over-the-wire" deployment system. This method involves a stainless steel filter with six struts converging to a cap with an axially oriented hole. This "hole in the head" is designed so that the filter can be deployed with a guidewire running through it. The guidewire

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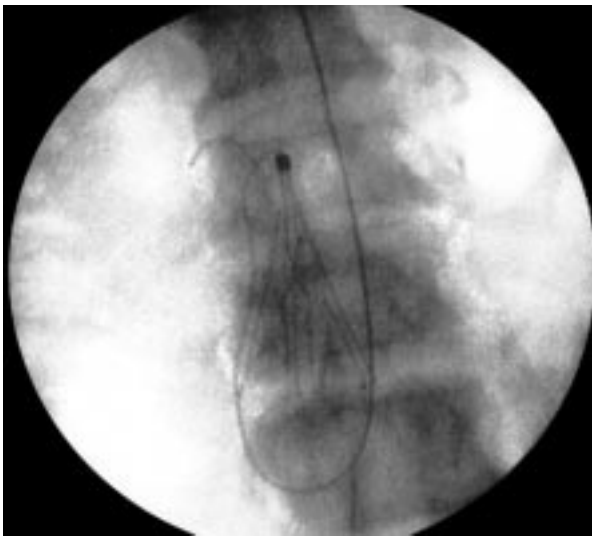

Fig. 1. Fluoroscopic view of guidewire entrapped in filter.

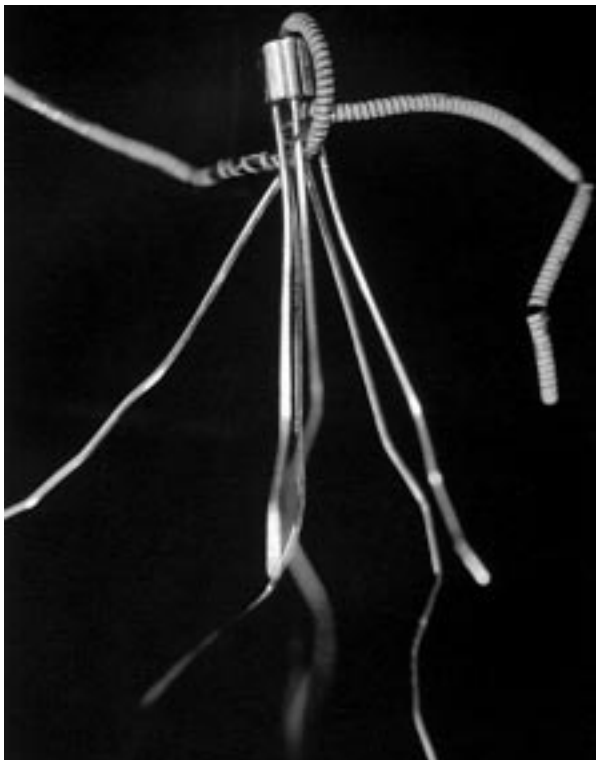

Fig. 2. Close-up view of guidewire entrapped in head of filter.

packaged with this system is a coiled spring over a solid core of stainless steel 0.035 inches by 180 cm. It is a straight wire with the distal 10 to 11 cm more flexible than the rest. This is designed so that wire can navigate through tortuous anatomy. The theoretical advantage of these modifications is that the filter can be positioned for deployment from a left-sided approach or through tortuous anatomy. The guidewire acts to stabilize the deployment of the filter and decrease the likelihood of a less-than-vertical deployment. Studies have shown that tilting of the filter may decrease the effectiveness of the ability to trap thrombus.[3,4]

Although there are numerous reports of complications from deployment of Greenfield filters,[5-8] to our knowledge this particular complication has not been reported. The reported cases of guidewire entrapment are from secondary procedures, usually central line insertion.[9-16]

For any filter to be effective it must be safe to use. This most recent modification of the Greenfield filter may have its own set of complications. The guidewire first introduced with the over-the-wire system was designed with a "floppy" distal segment. This design was intended to facilitate traversing tortuous anatomy. This is still the guidewire found in the femoral systems. It is possible for this floppy end to curl after exiting beyond the filter. The extreme flexibility of the guidewire tip may have been a contributing factor in causing the wire to entangle within the filter. The guidewire is a stainless steel core wrapped with an outer spring coil and coated with Teflon to decrease friction. The outer coil may actually hinder extraction by catching, unwrapping, and lodging in the head of the filter (Fig. 2). The manufacturer has replaced the guidewire in the jugular systems. The floppy segment is now only 1.5 cm.

Regardless of the access route for insertion, fluoroscopic guidance should be used to ensure that the guidewire exits straight. Any deviation of the wire should be adjusted before filter deployment. The new guidewire design for jugular approach should cut down the likelihood of the wire catching in the filter. As always, careful use of this device is necessary to reduce injury to patients.

CONCLUSION

The Greenfield filter has been shown to be safe and effective in pulmonary embolus prevention. The "over-the-wire" modification has yet to stand the test of time. This new deployment method has been used in our and other institutions for left-sided insertions without difficulty.[2] Fluoroscopic guidance and extreme care is essential for safe deployment of this new modification. It is important to maintain a straight guidewire through the filter to remove it safely after deployment. Avoidance of buckling reduces the likelihood of entrapment. The new guidewire design for the jugular approach should improve the ease of removal.

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